N.A.C.A. BULLETIN

In Two Sections

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VOL. XXIX, NO. 5 NOVEMBER 1, 1947

EDITORIAL DEPARTMENT NOTE

Variable, or flexible, budgets are becoming more and more widely known and used because they give recognition, in setting budget amounts for elements of cost, to the seldom absent factor of change in business volume. Each article on the subject of variable budgets is almost sure to touch on some special aspect not given the same emphasis before. The first article in this issue is no exception and, along with a brief review of the technique of variable budgeting, outlines a number of points of practice in the author's company, with stress on assistance to management in the solution of problems of volume now on the horizon, or nearer.

THOMAS D. FOY, the author of this presentation, is Supervisor of Cost Reduction of the Apparatus Manufacturing Division of General Electric Co., having been associated with the company for almost thirty-five years. He has held the positions of Works Accountant at the Schenectady Works and of Manager of the Bureau of Office Methods. Mr. Foy is a previous contributor to the *Bulletin*.

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Industrial strength lies in great part in the making of technological advances by individual companies. This fact was perhaps rediscovered in the war years and awareness of it is part of the current business atmosphere. As a consequence, accounting for research and development costs has assumed a new importance and a number of articles in this field have already appeared in the *Bulletin*. The distinguishing feature of the second article in this issue is that it is a case study of a company in which control of research and development costs unfolded from small beginnings and showed the way to control of such related items as machine construction and production engineering costs when conducted on a project basis.

GLAUD L. SMITH, the author, is connected with the Research and Development Department of Remington Arms at Ilion, New York. Mr. Smith went with his present company in 1941 on a wartime accounting assignment, after a diversified experience in accounting and other positions in the middle west.

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Foundry operations are first in process sequence in many large companies and are also receiving a higher rating in executive attention. Accounting for casting costs has its special problems. How they are being solved in one company maintaining a so-called captive foundry for grey iron castings is narrated in the final article in this issue. Of interest is the development, and uses made, of engineered standard costs, especially because these have not always been considered practical of application to foundries.

JOHN D. PAWLING, the author of this article, is Cost Accountant for The De Laval Separator Co., Poughkeepsie, N. Y. Mr. Pawling entered the employ of his company more than twenty-five years ago as payroll clerk and has held positions in all divisions of the factory accounting department, including Chief Shop Clerk and Chief Cost Clerk. He was Supervisor of government contract termination settlements for the company in the war period.

This *Bulletin* is published semimonthly by the National Association of Cost Accountants, 385 Madison Ave., New York 17, N. Y. Subscription price, $10.00 per year. Entered at the Post Office, New York, N. Y., as second-class matter August 28, 1925, under the Act of March 3, 1879.

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NATIONAL ASSOCIATION OF
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NOVEMBER 1, 1947

VARIABLE BUDGETS IN THE CONTROL OF COSTS

by THOMAS D. FOY,

Supervisor of Cost Reduction
Apparatus Manufacturing Division
General Electric Co., Schenectady, N. Y.

IT IS A RELATIVELY simple matter to determine quite accurately and quite definitely the total cost of a manufactured product, but the real problem is to know how much it should be and how to control it. Approach to this problem is by establishing standards and a readily applicable measuring system which will reveal variations from the standard. One such measuring system is the variable budget. Because business conditions are ever-changing, a variable budget is a useful guide for controlling costs. When properly applied, this device enables management to know what costs should be at different volumes of production, and variation in production volume, at least within limits, is one of the prime facts of business life.

This article is devoted principally to certain areas of one application of variable budgeting. However, it is hardly practicable to go on to the discussion of phases without a sketch relating to the subject as a whole. A grasp of the idea of flexible budgeting perhaps comes easiest upon inspection of a so-called break-even chart and one of simple construction is accordingly given in illustration (Exhibit 1). A method of determining fixed and variable elements of expense without use of graphs is also shown (Exhibit 2). The remainder of the presentation covers (1) the ready approach to control afforded by a flexible budget once prepared, (2) the problem of control of indirect manufacturing expense, which contains the largest number of mixed fixed-variable items, and (3) the special use of variable budgeting in attempting to prepare for the uncertain future of business activity. It is upon this use, we feel, that greatest stress must be laid so that the flexible budget may be a truly flexible defense, permitting rapid adjustment of cost elements to all production levels which outside conditions may force.

Getting the Picture

The familiar break-even point is only one of a number of interesting features which may be read from what is perhaps pref-

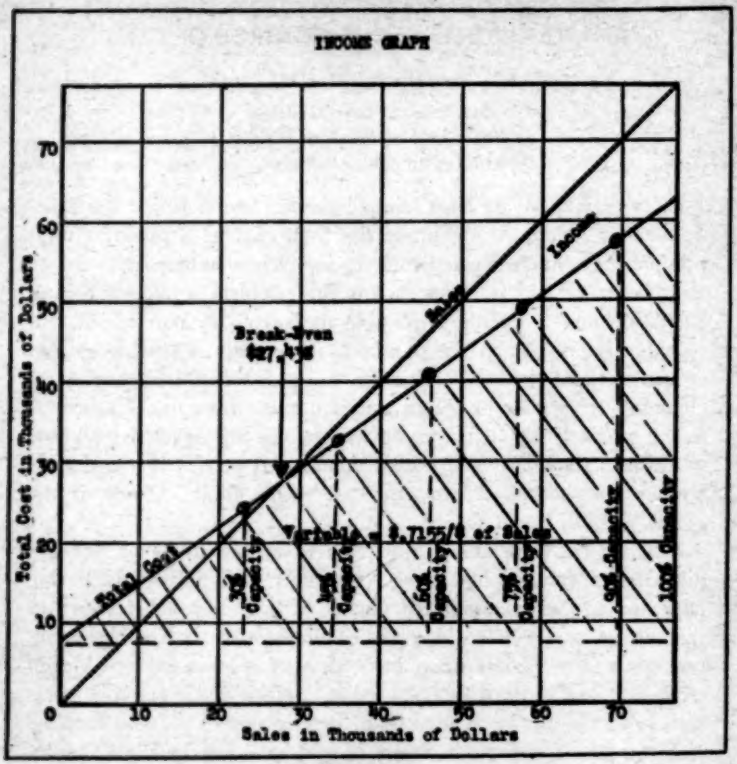

EXHIBIT 1

erably called an Income Graph. A simple graph of this type, intended to underlie a variable budget, is fairly easily constructed if two assumptions are taken as reasonably well in accordance with the facts, i.e., that fixed expenses will be the same at zero or capacity production and that variable expenses will be the same for each sales dollar, or perhaps each sales dollar value of production, direct labor dollar or other index of activity which may be selected in the course of studying particular expenses. There are ways of dealing with the shortcomings of these assumptions where it is important to do so. Ordinarily, carefully considered conclusions, based on these assumptions and on operations between 30 per cent and 90 per cent effective capacity, will give the practical degree of truth sought.

VARIABLE BUDGET—TABULAR FORM

	Expense Levels of Effective Capacity (Capacity—Sales $76,923)					
	30%	*60%*	*90%*	*Fixed expense*		*Variable per sales $*
Direct material	$ 6 360	$12 720	$19 080	$ 0	+	$.2756
Direct labor	3 000	6 000	9 000	0	+	.1300
Indirect mfg. expense	8 899	11 912	14 945	5868	+	.1311
Engineering, drafting, etc., expense.	3 180	5 460	7 740	900	+	.0988
Complaints	231	461	692	0	+	.0100
Other costs	346	692	1 038	0	+	.0150
Commercial and administrative expense	2 308	3 576	4 846	1038		.0550
TOTAL COST	$24 324	$40 821	$57 341	$7806		$.7155
INCOME FROM SALES (LOSS)	(1 247)	5 333	11 890			
% INCOME FROM SALES (LOSS)	(5%)	12%	17%			
SALES	23 077	46 154	$69 231			

Data for operation at 45% and 75% of capacity omitted from table.

EXHIBIT 2

The sales line plotted on Exhibit 1 simply as a diagonal which can be read equally well on both scales of the graph sets the cost objective: to get cost below it at as low a volume as possible and to keep the profit margin one which represents adequate return. Incidentally, an alternative construction of the chart would provide for reading of dollars, whether of sales or costs, on the upright scale, with percentage of capacity along the bottom scale. We prefer a chart which directs attention to sales dollars on the bottom scale, marked also with selected percentages of capacity.

Determining Fixed and Variable Elements

Obviously if the cost line is to be a straight line, it can be set by two points and, with this in mind, if total cost is estimated at the limits of the practical volume range, the line can be drawn. On Exhibit 1 the cost line runs between approximately $24,000 at 30 per cent capacity ($23,000 sales) and $57,000 at 90 per cent capacity ($69,000 sales). The difference in sales divided into the difference in cost at these two limits gives, on exact figures, variable expense of $.7155 for each sales dollar and the extension of the line to the upright scale gives the other key figure, i.e. fixed costs of $7,806. The company's break-even point is revealed to be $27,438 of equal sales and cost.

Position of the Cost Line

Of course the location of the cost line is not so easily accomplished as the foregoing might indicate. The position determined by study of costs at the extreme limits of practical operation should be tested by wholly independent studies of costs at other percentages of capacity. The chart given selects 45 per cent, 60 per cent, 75 per cent, and the thought is included that one of these, perhaps the 60 per cent ratio in this case, should reflect the current actual level of operations. If studies of costs at these volumes produce total costs which when plotted do not fall at or near the initial cost line, it may have to be adjusted. This is really only to say that the line, however drawn, represents a practical average based on the assumptions mentioned at the start of this brief explanation.

It will readily be seen that Exhibit 2 is constructed on the same logic as the income graph and that the same figures have been used omitting, however, two of the capacity levels charted. The additional information given in the table relates to individual categories of expense which would require either separate graphs or distinguishing lines if shown on the same graph. It is also likely that in carrying through the idea of control, the variability of many of the detailed cost elements could be better shown than by relationship to sales. There are some for which direct labor dollars would serve. To find the suitable base for still others will tax ingenuity.

For general consideration and over-all presentation, however, the sales base is serviceable. It results in the following equation using the values in our example, for cost applicable at any volume:

$$\text{Total cost} = \underset{\text{(fixed costs)}}{\$7{,}806} + \underset{\text{(variable costs)}}{\$.7155 \times \text{sales dollars}}$$

An alternative method of constructing a variable budget is to plot historical cost data adjusted to a common basis, rather than planned costs. This naturally opens new questions of desirability.

The Effect of Interruptions in Plant Operations

The activity base to determine the amounts of expense allowable under the budget in the categories which are regarded as variable will be shortened when holidays or other interruptions occur, especially if direct labor is the activity base and this will have the effect of a gremlin in the works if it is not taken care of. In our

Massachusetts plants, for example, there are eight weeks in which holidays fall, one inventory week, and two vacation weeks.

Variable budgets can be established which will recognize higher expense for the shorter week and thereby be more reasonable of attainment. Statistics might show that these weeks vary from a full week as follows:

	Direct labor per cent full week	*Indirect labor per cent full week*
Holiday weeks	80	90
Inventory weeks	70	90
Vacation weeks	20	50
Full weeks	100	100

Fixed expense will not be changed but the variable factor will be slightly lower than average for a full week and somewhat higher than average for the shorter weeks to give the over-all variable expense budgeted for the year.

The Emergence of Control

If management is not satisfied with the anticipated net income before taxes at the various levels of sales, as shown by the relationships plotted or calculated, perhaps the next step is a more detailed analysis by elements of costs to determine what must be done to obtain a net return which will satisfy. This is the high road to cost control and cost reduction based on knowledge of facts and rational conclusions drawn from them. Such an analysis might be directed towards:

1. Simplification of organization
2. Simplification and standardization of routines
3. Elimination of activities
4. Redesign of product
5. Improving methods
6. Scheduling production to minimize premium payments for overtime
7. Establishing standards of performance on repetitive jobs
8. Reduction of maintenance
9. Economies in the use of expense materials, such as small tools and supplies
10. Conservation of power, steam, water, gas, compressed air, etc.
11. Reducing amount of investment in manufacturing plant

12. Improving turnover of inventories
13. Other

These are all fertile fields for investigation in any business against a systematic background of planning. Then, if the required reductions have been accomplished, adjustment is made in the bases of cost at the various levels, resulting in satisfactory anticipated net income.

The same procedure can be carried out for each of the elements of costs. As a general rule, direct material and direct labor will be 100 per cent variable. There are some exceptions, such as price extras and setups. Indirect manufacturing expense, engineering, drafting, etc., and commercial and administrative expense will be at fixed amounts plus a variable amount. Other miscellaneous costs generally will be 100 per cent variable. Nevertheless, constant alertness is necessary so that wholly erroneous assumptions about particular items will not come to prove troublesome.

Making the Control Stick

Variable budgets merely perform the function of a standard or a measuring system, flexible with volume. One special service is to spot unsatisfactory results which might otherwise not only be overlooked but even mistaken for attainment of an objective.

As an example, assume a case in which management has decided that net income, before taxes, of 15 per cent of sales will be satisfactory, and an income figure is forecast based on anticipated sales volume. Variable budgets for all elements of cost are prepared. Perhaps the profit and loss statement for the period in question does finally show net operating income equal to 15 per cent of sales, making it appear at first glance that the requirements of management have been met. However, further inspection and analysis might disclose that actual sales volume exceeded anticipated sales by 20 per cent, that operating income should have been 19 per cent of sales at actual volume, and that costs for the period were over the budget by 4 per cent of sales. Of course, the proper controls would reveal this more promptly.

Some Peculiarities of Expense Behaviour

There are certain special considerations which often become important in the preparation and administration of particular parts of a variable budget of indirect manufacturing expenses. Three such instances come to mind:

1. The theory of variable budgetary control, if a straight line is employed representing variation in direct ratio to sales or other activity base, assumes that the applicable cost elements may be infinitely divided (or multiplied) in proportion to the base, which is less and less true at extremes of volume and particularly as the base shrinks toward zero. However, a straight line related to an appropriate base does fairly represent the variable element in actual requirements for a particular function. Material expense will follow straight line variation as an average more closely than will labor expense because the unit of supply is a smaller percentage of total requirements.
2. There are certain expense items which vary in proportion to one base under certain conditions and in proportion to a different base under other circumstances. Examples are steam and electricity. The former, when used for heating, has a seasonal base and, in general, a production base when used for processing. The latter has a seasonal base when employed for lighting, whereas industrial power current varies with production but not in direct ratio. If power is generated, the cost will vary seasonably because largely dependent on the cost of producing steam. A certain amount of judgment is necessary in handling these items.
3. There are nonrecurring expense items of various sorts which may often be of considerable size. Among this are major projects for equipment rearrangements and for repair of buildings. Contributions sometimes fall in this general group of expenses. Such items are best handled separately from the variable budget, on a project basis. They are not easily based on activity indices such as direct labor, which may serve for many items. However, such treatment may create some disagreement as to what is the dividing line between items to be considered unusual and nonrecurrent and those to be provided for in the regular variable budget. The main point is to treat items of this character in such a way that there is control of the expenditures and so that the method of reporting them does not introduce distortions into comparisons of the normal budget with current normal expense.

Basis of Variable Budgets for Indirect Labor

Indirect labor is the cost of supervision, clerical work, services, etc. Like other costs, it has fixed and variable elements. It is incidental to actual production which renders the volume of production the logical basis against which to measure the variable portion. A readily available index of volume of production is often desirable for this purpose. In repetitive manufacturing of identical units or in enterprises where the output can be expressed in some common unit such as gallons, tons, etc., the unit of output is a preferable index of volume of production. On the other hand, if there are many lines and types of product, then direct labor dollars or productive man hours is probably the better all round index.

In establishing a variable budget for all volumes of production a schedule of indirect labor must be established at various points of output and a simple equation derived which will give the allowable indirect labor at any volume of production within a given range of operations. Both with respect to numbers of employees and amounts to be paid, indirect labor is generally classified by various subdivisions of indirect manufacturing expense, such as supervision, clerical, service, maintenance, etc., and in many cases further subdivided into supervisors, foremen, inspectors, production clerks, accounting clerks, helpers, laborers, etc. In the determination of the budget requirements for these various activities, each individual job should be considered and the following questions answered before proceeding to the estimate:

1. Is the job essential? That is, does it contribute to profit? (This is wholly a matter of judgment.)
2. Is the job worth the anticipated payment? (A matter of salary or job evaluation.)
3. Is the right individual on it? (A matter of employee evaluation.)
4. Is the method efficient? (A matter of judgment based upon knowledge of conditions.)

Mechanics of Indirect Labor Control

Having determined how much the indirect labor should be at all volumes of direct labor or other index within the normal operation range, the control of such indirect labor consists of dealing

with the exceptions. At the beginning of each month, each division head should be required to prepare and submit to management an estimate of the amount of direct labor, by weeks, to be applied for the next month's operations, and also the indirect labor detailed by subaccounts and compared with the budget allowance. Any anticipated overexpenditure of the budget allowance for any account must be explained to management and should show the following:

1. The reason for the overexpenditure and how long it will continue.
2. If the condition is not a result of a temporary or abnormal situation, what steps are being taken to correct it?

If the forecast of operations should happen to indicate a reduction in direct labor, the expenses of all units in the organization can be reviewed critically and the reduction necessary to meet the reduced allowance planned.

Such a procedure is active expense control, that is, the trend of expense is directed rather than followed. Plans must be kept up, however, accomplishments checked, and failures analyzed. This means analysis of the actual expenditures incurred in comparison with the budget allowance and forecast. Reports should show the difference between actual expenditures and budget allowances for the current week and also for the year to date. The realization percentages, i.e., the ratio of budget allowance to actual expenditures for the week and year to date, are generally indicated also. Through such a report, management gets an immediate and comprehensive analysis of the indirect labor expenditures.

Other Indirect Expenses

The same procedure should be followed with indirect manufacturing expense other than indirect labor, and is also followed by divisions, etc., if the company is organized into departments manufacturing different products and subdivisions thereof, including productive, service, and administrative divisions. To sum up the idea of control under a variable budget, it may be said that control of cost necessitates knowledge of "how much it should be" and "how much it is." The variable budget is a standard that will tell "how much it should be." Actual performance is "how much it is." The difference between these amounts must have constant attention to be kept at a practical minimum.

A Current Use for Variable Budgets

We are emerging from a high-volume, high-cost period of production into what may well be a lower-volume period and must be one of lower production costs. Our company's experience with variable budgets dates back to the post depression days of the middle 1930's. At that time, we were faced with the problem of controlling the cost of increasing volume in the face of higher material prices and wage rates. With the constantly changing demands on our manufacturing plants, it was found that a more flexible plan of budgeting than ever before was required, one that could change quickly with any change in the load placed upon the factory. The answer to this was found in the variable expense budget and while this type of budget, or any budget for that matter, does not relieve management of its responsibility to keep expense at a minimum, it did provide a good tool for measuring expense performance.

This tool was pretty much laid aside during the war. The guiding philosophy became production regardless of cost. We did not use variable budgets generally throughout the company in those years. Emphasis was placed on the highest possible output and our plans made accordingly. Now, as we look into the future, we have two jobs to do in getting back to the control viewpoint. First, we must reduce our expense to a reasonable level at the current high volume of output and, second, we must be in a position to adjust our sights rapidly with a descending factory load, should business take a turn downward. This viewpoint rather combines cost control with cost reduction, for the latter may provide the means to make required changes without dislocation or profit loss. Our thought might be called "cost protection." The variable budget is again our tool.

Our specific method has been to prepare variable expense budgets influenced by operations from 1938 through 1940, adjusted for material and wage cost increases since then. To apply the rate of expense developed in this way to the current productive load is the substance of our first move and is requiring a considerable amount of managerial pressure. The diagram in Exhibit 3 shows the location of current indirect manufacturing expenses, related to direct labor, above the level of the same group of costs budgeted at prewar volume with adjustments to today's prices and labor rates. You can see that we have a difficult job

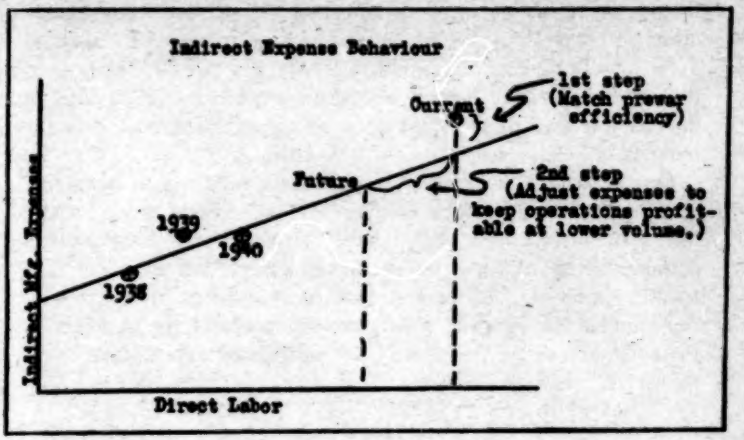

EXHIBIT 3

to do even if volume keeps up. The second step diagrammed is even more strenuous. We must be prepared to reduce expenses quickly if the direct labor load falls off, and do it in accordance with the variable budget as shown. The expense reduction which would be needed is apparent.

Taking Soundings for Management

The attitude of our management further illustrates the points made and their pertinence to the present.

When we prepared the 1947 operating budgets, we were in the situation prevalent in industry, that is, our backlog of orders assured peak operations for the year. But what would a recession in business do to this backlog? What would the attitude of labor be? Would we be faced with a shutdown of our own due to labor difficulties? Would material be available in sufficient quantities to support peak operations even without a general strike in the industry? If the coal or steel strikes came about, what then?

After our plant budgets had been prepared, the company executives asked for a budget at reduced output which would recognize these uncertainties. It was made up with quite definite knowledge that we would start the year at a high level of operations but that, because of the current economic hazards, we might be required to curtail operations drastically at a moment's notice. Without a

flexible or variable plan, we would be unable without considerable effort to control our indirect manufacturing expenses to the level of a rapidly descending production load. It can be clearly seen that with a variable budget we are in a much better position to do this job than if we relied upon inflexible, stationary, or static budgets.

Our reports also reflect the importance attached to budgeting in planning management's course. We supplement weekly statements of direct labor and monthly statements of total indirect manufacturing expense by requiring supervision to make one-month, six-month, and twelve-month commitments of their operations under the budget. This gives management the opportunity to revise or change the plan if the anticipated expenditure seems excessive.

COMING ARTICLES

In the *N.A.C.A. Bulletin*, November 15, 1947

Analytical and Accounting Control of Sales and Gross Profit by Punched Cards

by Lester P. Riddle

Determination of Scrap Allowance—Stage of Completion Method

by Andrew J. Hieftje

Installing Manual Fixed Asset Records

by Donald R. Thompson

HOW WE DEVELOPED CONTROL OF RESEARCH AND DEVELOPMENT COSTS

by GLAUD L. SMITH

Research and Development Department
Remington Arms Co., Ilion, N. Y.

CONTROL OF RESEARCH and development costs has been ably presented by Robert H. Robnett of the Massachusetts Institute of Technology, in his article "Control of Research and Development Costs" published in the *N.A.C.A. Bulletin* for July 15, 1946. Attention was called to the establishment of research divisions by many companies for the first time, the expanding of the scope of research by others, and to the situation of those still seeking methods of keeping abreast of the rapid strides now being made by scientific and technological development.

Professor Robnett's carefully prepared paper, together with its presentation of a case study, preparation of the budgets, reports, and exhibits illustrating the accounting procedure involved, covers the subject very completely. Perhaps, however, the story of how we approached our problem and developed an adequate and effective control of these costs might be of some interest to others who are feeling their way on this subject. Especially in mind are those who are wondering just where to begin and how far to go. Our experience would suggest that they should at least make a start and then build as best serves their individual needs.

How We Started

We were requested to set up a very simple control within the technical division and, to start with, wholly independent of the company accounting department. This was to be a control for the use of the technical division manager. It was to be for the sole purpose of keeping him well informed of all charges made against each individual project and to provide the total accumulated expenditures, the amount of the authorized funds, and the unexpended balance in each case. The assignment appeared to be an easy one, so we began by examining just what we had to work with.

Many companies might have had a second thought at this point. We had in force a budget which was duly approved by the unit

superintendents, the division manager, the technical director, and the board of directors. This budget was prepared by the unit superintendents, and was classified as to the total salary and wage roll, assistance from outside sources, materials purchased, travel, and miscellaneous expense, which the units would require for the current year. Each unit prepared its own budget and then these were assembled into one budget for the entire division. Besides the existence of orderly budgets, research and development work was already systematized on a project basis. Each project stated the purpose and the scope of work to be undertaken and the approximate completion date. Each project was reviewed in relation to the finished product for the purpose of determining anticipated return on the investment. Moreover, the accounting department was doing exactly what we had been requested to do, namely, accumulating all expenditures against each project and rendering a monthly report of the financial status of each project.

What could we provide, then, that was not already present? The answer was: the same information *today, while it is news,* letting the accounting department continue to assemble factual information for official use and record. Our decision having been made, the following plan was set up and our control was on its way.

The Steps of the Plan

Our initial program shaped itself in accordance with the following five points:

1. Our starting point was obtained by taking the total accumulated expenditures of each project as shown by the last monthly report issued by the accounting department.
2. The source of all expenditures was determined and provision made for their clearance through our control group.
3. Simple, adequate records and reporting forms were set up.
4. Actual salary and wage roll data of all personnel was secured and a standard overhead or burden rate established.
5. A "sales promotion policy" to sell the department personnel on the entire control program and draw out their full cooperation was set in motion. Without this, we felt our control program would be doomed to complete failure.

Although all steps were important, it is the third one, dealing with records and reporting forms, with which the major portion

of this article concerns itself. Considerable work was required, of course, to get the necessary information actually funneling through our control group, but we met with the hearty cooperation of all departments and in a reasonably short time the proper procedure was complete and became a part of routine. The wage and payroll data which we obtained became, in itself, a favorite record of the division manager. The "promotion" angle was approached with some caution. At last a general meeting was held to explain the program and its purposes. The result was gratifying. Even the time reporting requirements which we placed on all individuals in the division met a cooperative reception.

The First Set of Records

Nevertheless, the information we obtained from within and without the division, the records we kept, and the form of report issued weekly to the division manager were all on an essentially simple scale, so much so that the urge to write out for the benefit of others the procedure developed would hardly have come if the basic idea of maintaining control information had not taken an unexpected hold on division personnel. However, this portion of the subject is properly reserved for a later place in the narrative.

Our initial record to accumulate the charges to the projects, data for which cleared through us under the new routine, was a nine-column control sheet for each project. Postings were made weekly, in separate amounts for each work order of which the project was composed, under the following seven column headings:

Salaries	Materials and supplies
Wages	Travel and miscellaneous
Outside assistance	Overhead

Daily expenditures

The remaining captions carried: (1) cumulative total to date of expenditures under the project and (2) the unexpended balance, based on total amount authorized as shown in the information at the top of the form, which also included project number and name, and the date approved. Later another column was added to the form to indicate the portion of the unexpended balance which was committed to particular outlays.

The source of the data posted to the form is of special interest at some points as reflecting our desire to maintain up-to-date information with a practical degree of accuracy.

Salary and wage information will serve as an instance of this. Each individual working on a project was required to turn in a daily time sheet showing to the closest half hour the work order numbers and project numbers on which his time was spent that day. The time sheets were given to the division cost clerk to apply each individual's average hourly rate of pay to the hours worked and to obtain totals of time chargeable to each work order. One entry daily was made to the control sheet for each work order.

Outside assistance was posted daily from a report furnished by the time department of the plant. Material and supplies purchased were posted weekly from a master tabulating machine run which was also furnished by the plant. Travel expense was taken direct from the applicable expense reports which cleared through our control group under regular procedure. Overhead was charged on the project control sheets on the basis of the salary and wage roll, using a fixed percentage.

It soon was apparent that commitment information was necessary if we were to toe the mark with up-to-the-minute control of the status of our projects and their component work orders. This was done by using a 3" x 5" card and a control sheet for each work order and adding another column to carry this element of the situation on the project control sheet. Commitments were balanced once each week and the necessary postings to the project control sheet were then made by using the debit or credit figure, indicating change in outstanding commitments, obtained by balancing the commitment control sheet of each work order applicable to the project.

The Weekly Report

You will recall that this was all arranged to help the division manager by giving him promptly—each week as it turned out—similar information to that which would come along on regular accounting department reports some time after the end of each month. The weekly report rendered him was not particularly detailed considering the information that went into our project control sheets. The form is shown as Exhibit 1 and may appear exceedingly simple. It required a minimum amount of work and was strictly a status report. It showed the detail of what happened during the week only when read in conjunction with the previous report. Nevertheless, it was clear and accurate and was

WEEKLY FINANCIAL STATUS

Technical Projects, Week Ending ——————

Project No.	*Name*	*Amount authorized*	*Amount expended*	*Unexpended balance*
NP-3212	Project name	$ 50,000	$ 10,200	$ 39,800
XX-55	Project name	100,000	28,500	71,500
	Total	$——	$——	$——
	Less total previous week			
	TOTAL SPENT THIS WEEK		$——	

EXHIBIT 1

received as a step toward fingertip control of research and development expenditures.

Our plan as originally conceived was now working. The manager was getting the information he wanted regularly each week and, on projects where the expenditures were nearing the amount authorized, he could secure fairly accurate information on a daily basis. Our "sales promotion policy" had paid dividends. Personnel all along the line realized that we could furnish information which was of value to them as well as to the division manager. What was made available "tasted like more." Perhaps we were a little surprised. More control features and more detailed reports were asked for and our "growing pains" had just begun!

Uniform Breakdown of Projects

What form should the additional information take? After making a careful study of the projects we arrived at the conclusion to break each project into units of work performed and also allocate the funds authorized in the same way. By so doing our control would tell much more than it had in the past. If proper records were made to follow this breakdown, we would know at all times the relationship between actual progress and dollars spent in considerable detail. What is more, we could close each unit of the work separately, thereby stopping any further expenditures thereon and preventing savings from being inadvertently absorbed in overruns on other units of the work. We would secure a better basis or measuring stick for estimating the cost of development work of a similar nature. Better budgeting by the superintendents would be possible.

After getting the "green light" on this plan, we proceeded to establish a unit breakdown for research and development projects

on a uniform basis. The following outline shows the results in terms of major and minor units of work:

1. Design
   a. Investigation
   b. Design and design revisions
   c. Model making and model testing
2. Specifications
   a. Raw material procurement and metallurgy
   b. Testing the finished product
3. Production engineering
   a. Processing and process sketching
   b. Trial run
   c. Pilot operations
4. Tool design
   a. Tool design
   b. Tool design revisions
   c. Tool revisions
5. Administrative
   a. Project engineering
   b. Engineering files

Change All Control Records

Detailed information comes at a price. If we were to have control down to the point indicated by such a breakdown, it would be necessary to provide accommodation in our records. No longer could our weekly reports be made on a total figure basis. Personnel responsible for each unit in the project breakdown needed facts if they were to control expenditures effectively. Therefore, while retaining as a basic record a work order control disclosing expenditures by source in the same manner as our first project control sheet previously described, we set up a "master" project control sheet carrying a monthly distribution of expenditures under each project in columns for each of the five functional units shown above and "unit" control sheets carrying a weekly columnar distribution corresponding to the subheadings of the breakdown outline. Double columns were used in each case to permit crediting each function and subfunction with the proper portion of the authorized funds. The expenditures were placed in the debit column and a running balance of authorization unexpended could

be kept by pencil notation. These two control sheet forms were completed to the left of the distribution columns by date and entry columns and to the right by a double column for totals. The unit control sheet contained at the left a work order number column as a reference to entry source. The reference shown on the master control sheet built on this and indicated the unit control sheet as the source.

Place of the Work Order Control

The work order control sheet, which was very similar in form to the one used in our original setup for the project, assumed a new importance as the underlying record. All detail was entered on this sheet daily, the complete breakdown being: (1) salaries and wages, (2) assistance from plant, (3) materials purchased, (4) travel, (5) miscellaneous, and (6) overhead. In addition to this detail there was the date and a space for description of purpose and three columns for totals and balances, as follows:

	Expended		Authorized		Totals	
	Weekly	Daily	Dr.	Cr.	Expended	Balance

The work order control sheet thus was our means of supplying special or detailed information on call and of carrying periodical information up to the master and unit control sheets. When a work order was issued, an authorized amount was set and credited to the work order. Additional amounts as granted under the work order were entered in the same manner. If the work order was reduced, or when it was closed, use was made of the debit column. By referring to the expended column we could any day determine that day's expenditures. The weekly total was transferred to the unit control sheet.

Project Status Report

Naturally our reporting followed the progress shown by our control forms. The somewhat bare report set forth as Exhibit 1 was amplified by a weekly report for each project showing the status of each unit (Exhibit 2). Since this report must serve a greater number of individuals and contain adequate information for all, it necessarily followed the pattern of the project breakdown. The over-all picture given by the master control sheet was available as a monthly report.

PROJECT No. XX-55, (Name)

Financial Status, Week Ending .....

	Amount authorized	*Total spent*	*Balance unexpended*
	$	$	$
Design:			
Investigation			
Design and design revisions			
Model making and testing			
Subtotal	$	$	$
Specifications:			
Raw materials and met.			
Test finished product			
Subtotal	$	$	$
Production engineering:			
Processing and sketching			
Trial run			
Pilot operations			
Subtotal	$	$	$
Tool design:			
Tool design			
Tool design revisions			
Tool revisions			
Subtotal	$	$	$
Administration:			
Project engineering			
Engineering files			
Subtotal	$	$	$
GRAND TOTAL	$	$	$

EXHIBIT 2

Combination with Accounting Department Controls

There was yet another change to take place. The real value of our control was becoming more apparent. Top management saw in it an instrument for maintaining control of the entire development program to assist in evaluationg each project, particularly with regard to its investment or earnings value. As stated before, we were not an official unit of the accounting department and, in part at least, our control records duplicated accounting records. Could accounting records be made to furnish the control desired without losing some of the ground that had been

DEVELOPMENT PROJECT NO. .....

Weekly Report of Expenditures for the Week Ending .....

Master work order	*Master work order part*	*Spent this week*	*Spent and commitments to date*	*Total amount authorized*
1	*Development*			
	Design			
	Investigation			
	Design			
	Design revisions			
	Model making	_____	_____	_____
	Subtotal			
	Specifications			
	Testing			
	Specifications	_____	_____	_____
	Subtotal			
	Product Engineering			
	Process engineering			
	Trial run	_____	_____	_____
	Subtotal			
	Tool Design			
	Tool design			
	Tool design revision			
	Tool revision	_____	_____	_____
	Subtotal			
	Administrative			
	Project engineering			
	Engineering files	_____	_____	_____
	Subtotal			
	Total of M.W.O. 1			
2	*Tooling*	_____	_____	_____
3	*Special machinery*	_____	_____	_____
4	*Standard machinery*	_____	_____	_____
5	*Production aids*	_____	_____	_____
6	*Pilot operations*			
	Quality audit			
	Methods engineering			
	Mach. changes and additions			
	Mach. rearrangement			
	Pilot lot manufacture			
	Tool replacement			
	Credit O. K. product	_____	_____	_____
	Subtotal MWO 6			
	Total M.W.O. 1 & 6	_____	_____	_____
	GRAND TOTAL	_____	_____	_____

EXHIBIT 3

DEVELOPMENT PROJECT NO....

Monthly Report of Expenditures and Physical Progress For Month of June, 1946

Master work order	*Master work order part*	*Spent this month*	*Spent and commitments to date*	*Total amount authorized*	*Total project estimate*	*Total indicated cost*	*% Complete*		*Remarks*
							Physical	*Financial*	
1	*Development*								
	Design								
	Investigation								
	Design								
	Design revisions								
	Model making								
	Subtotal								
	Specifications								
	Testing								
	Specifications								
	Subtotal								
	Product engineering								
	Process engineering								
	Trial run								
	Subtotal								
	Tool design								
	Tool design								
	Tool design revisions								
	Tool revisions								
	Subtotal								
	Administrative								
	Project engineering								
	Engineering files								
	Subtotal								
	Total of M.W.O. 1								

(Additional captions reflect Master Work Orders Nos. 2 to 6, as shown on Exhibit 3)

EXHIBIT 4

gained, thereby eliminating this near duplication of records? In studying this problem we found that similar controls were being kept on all construction projects, many of which were a part of the development projects. All were in the development program. It was decided that they should be brought together.

The process of doing so represented an integration of control of all elements of our development program and was built directly on the controls we had developed for the assistance of the manager of the technical division and then for the benefit of technical division over-all and unit staff. To the five elements distinguished in our project breakdown and our weekly project status report—design, specifications, production engineering, tool design, and administration—we added categories of tooling, special machinery, production machinery, and production aids, and we segregated pilot operations. Revised weekly and monthly project reports prepared on this more complete basis are shown as Exhibit 3 and Exhibit 4, respectively. The five strictly development classifications are designated as master work order No. 1, and so related as a whole to work orders of our division. The four enumerated additions, as well as pilot operations, are referenced to master work orders Nos. 2 to 6, respectively, and in this way related to the detail work orders not primarily or solely in the province of the research division. However, the point is that the full sequence of research and resulting operations are reported and controlled together.

Final Status of Control

The authorization of funds was now made to the project by master work order, work unit, and subdivision, in conformity with previously prepared master estimates of funds required for the development and completion of each project. The report forms were revised to provide weekly and monthly reports as previously indicated. The week in which the monthly report was issued no weekly report was required.

The accounting department made the necessary adjustments to its system for assembling all the detail for rendering these reports from the official accounting records and the responsibility now is vested where it belongs. We have cost control of research and development.

AUTHOR'S CORRECTION TO

PAYROLL ACCOUNTING BY PUNCHED CARD METHODS

A paragraph entitled "Time Cards" on page 1514 of the *Bulletin* for August 15, 1947, contains material which is incorrect and misleading as general information. The amount of $49.06 cited, should read $59.06, and the following sentence should be deleted:

"Also, workmen's compensation insurance need not be paid for time not actually worked; for example, the eight hours in the first line labeled 'Excess Time Computed,' representing wages paid for a holiday when the employee did not work comes in this category."

Upon checking with the insurance companies, I find that in some states holiday wages should be included in calculating the workmen's compensation insurance premiums, and also vacation wages. The latter, while not mentioned specifically in the sentence, might be construed as falling in the same category. Exhibit 1 should also be changed to read in the following manner:

DAYS WORKED	HOURS	RATE	EARNINGS
5	47¼	1.25	$59.06
EXCESS TIME COMPUTED	3½	.625	2.19
GROSS PAY			$61.25

I suggest that any reader intending to follow this particular phase of the routine, would do well to check the law regarding the manner of paying workmen's compensation premiums in his own state, and establish his methods in accordance with his findings.

SAMUEL J. NOAH.

A COST SYSTEM FOR A CAPTIVE GREY IRON FOUNDRY

by JOHN D. PAWLING,

Cost Accountant, The De Laval Separator Co.,
Poughkeepsie, N. Y.

THE MANUFACTURE of our products requires about 2,000 tons of cast iron annually and this requirement we meet in our own foundry in which we also produce castings for others as fill-in business. Our end products are centrifugal machines for the separation, clarification, purification, and dehydration of liquids with components of differing specific gravities. These include milking machines and cream separators for farm and factory use ranging in capacity from 225 pounds to 20,000 pounds of milk per hour and industrial oil purifiers of various capacities. Accordingly, the castings made vary in weight from a small fraction of a pound up to five hundred pounds each, and in shape from a simple chunk of metal to an intricately cored casting. The principal advantages we have found in conducting our own foundry are: flexibility of production schedules, ready availability of new quantities and styles, control of product quality and cost from the beginning, and easier experimentation with present and proposed new products.

Characteristics of the Foundry

From a process viewpoint, the outstanding feature of our foundry is its electric furnace for melting operations. The outstanding organizational feature is an incentive plan which covers all direct and some indirect labor, based on time allowances established by time study. We feel that our cost system is also outstanding and likewise different from that in force in other foundries of which we have knowledge in that it provides individual piece costs as well as costs per pound. The latter alone, it seems to us, can be a snare and a delusion. Our system has come to satisfy us as a tool for cost control, establishment of prices for our end products, and for inventory valuation, and we consider these three uses the test of a cost system.

It would be correct to say also that standard costs are a feature of our cost system for we have and use, in a manner to be descibed, carefully engineered standard costs for all foundry materials and operations, developed into the per piece costs referred to and regarded as invaluable for pricing assistance and inventory valua-

tion, and helpful in other directions. However, in the control of costs, actual costs play the major role.

Departmentalization of Operations

A brief indication of the operations which foundry cost records must reflect is a rather necessary preliminary to further particulars of the system. These operations are departmentalized to (1) melting, (2) molding, (3) core-making, (4) annealing, (5) cleaning and priming, and (6) inspecting, together with general overhead consisting of administrative expense and labor and material not specifically chargeable to an operating department. The melting operation begins with the assembling of melting stock and ends with the delivery of the molten metal to the molding floor. The molding department prepares the sand and shapes the mold, receives the molten metal and pours it. "Shake-out" and "cut sand" operations are performed. The core department operations (to complete the molds) include mixing the core sand, and molding and curing the cores. The cleaning department tumbles, sandblasts, grinds, and primes, and the annealing department accomplishes all stress relieving operations. There is preliminary and final inspection.

Account Detail Provided

Labor and supplies, direct and indirect, figure in the costs of all departments and are charged on daily time cards and requisitions, respectively, to the proper category in operating account detail. Metal cost and the power costs of the electric furnace are

Departmental Code

611 Melting
612 Sand molding
614 Core making
615 Cleaning and finishing
616 Annealing
617 Inspection and general overhead

Account Suffixes

–00 Direct material
–10 Direct labor
–20 Indirect labor
–30 Supplies
–31 Electrical energy and fuel oil
–32 Special departmental supplies
–50 Patterns and flasks
–70 Repairs

–80 and –90 General expense

–80 Supervision and clerical
–81 Inspection
–82 General labor
–83 General supplies
–84 General light, heat, and power
–85 Administrative
–86 Repair and maintenance of buildings
–87 Insurance and taxes
–88 Depreciation
–94 Welding castings
–95 Overtime bonus
–96 Holiday pay
–97 Laboratory test

principal elements with respect to the melting department. A summary of the account coding in use is shown on p. 292.

Monthly Over-all Report

Our principal monthly report to top management (Exhibit 1), which is both comparative and to a certain extent statistical, is prepared on the basis of actual costs derived from these accounts classifications. The over-all result of application of standard costs makes its appearance, however, at the bottom of the statement, which shows in pounds and cost the good castings delivered to the main plant during the month. These are foundry "sales," although at cost, and the difference between actual and standard costs of these deliveries is here shown as charged off as "closed order adjustment."

Construction and Uses of the Standards

Each prospective order passes through the methods department, as an initial step, where process engineers predetermine a standard routing of the productive operations necessary to create the casting. A trained time study engineer then sets the standard time for each operation on the layout, from data which has been compiled by the time study engineering staff. This gives rise to the form shown as Exhibit 2 and entitled "Standard Routing, Rates and Cost." From this information a standard cost is calculated in full departmental detail and termed a "transfer value" from one of its principal uses. This takes the form of Exhibit 3, the Iron Foundry Cost Card. The columns provided for revision make for current standards, giving effect to improved methods, material analysis changes, or reduction in losses from defectives.

Showing casting deliveries to the plant at standard cost in the transfer value displayed at the bottom of Exhibit 1 goes along with the fact that standard costs are the basis for the valuation of inventory of castings. Further, it is the basis of the inventory valuation of casting components in inventories of the company's main line of products. Standard costs are also relied on to assist in price quotations issued for plant end products and we feel quite certain we would rely on them a great deal less if they were not worked up on a per casting basis, rather than on a per pound basis only. Our entries in the accounts also recognize the standard costs.

All materials entering into the foundry are charged at standard value and the same is true of labor and burden, based on standard

THE DE LAVAL SEPARATOR COMPANY — POUGHKEEPSIE WORKS

COMPARATIVE STATEMENT FOR PERIOD NO. 1 — ENDING January 31, 1947

(Values shown are NOT ACTUAL — they are shown for illustrative purposes only.)

1946 To Date	1946 January	IRON FOUNDRY OPERATING STATEMENT	1947 January	1947 To Date
	349,200 lbs.	Metals Charged	404,732 lbs.	
	336,977 lbs.	Good Castings Produced	402,297 lbs.	
	83.7	% Good Castings	87.3	
	12.2	% Bad Castings	7.5	
	3.4	% Foundry Returns	22.5	
	4.4	% Loss in Melt, etc.	2.8	
	100.0	% Total Charge	100.0	
	19,660	Total Man Hours	20,422	
	23	Number of Working Days	23	
	181	Average Number of Employees	98	
	17.2 lbs.	Good Castings per Man Hour	19.9 lbs.	
	$ 1.408	Avg. Hrly. Rate (Incl. Overtime)	$ 1.481	
	" 1.265	" " (Excl. ")	" 1.543	
	22.37 Cts. Per	Fig. Iron	20.31 Cts. Per	
	$ 6,211.	Melting Dept. - Metals & Alloys	$ 7,176.	
	816.	Melting Labor	1,027	
	1,932.	Electric Energy	2,053.	
	851.	Electrodes	732.	
	977.	Furnace Maintenance	1,116.	
	114.	Other Maintenance & Supplies	91.	
	$ 10,931.	Total Metals & Conversion	$ 12,195.	
	- 1,864.	Returns & Bad Catgs. (Metal Value)	- 1,902.	
	$ 9,067.	Melted Metal Cost in Good Castings	$ 10,293.	
	2,774.	Core Room - Direct Labor	3,339.	
	911.	Indirect Labor	1,697.	
	1,070.	Supplies & Maintenance	1,093.	
	7,351.	Sand Molding Dept. - Direct Labor	10,644.	
	3,036.	Indirect Labor	2,853.	
	2,594.	Supplies & Maintenance	2,713.	
	2,210.	Clean. & Fin. Dept. - Direct Labor	3,478.	
	3,019.	Indirect Labor	2,854.	
	2,229.	Supplies & Maintenance	2,721.	
	432.	Annealing Dept. - Labor	208.	
	207.	Fuel Oil, Supplies & Maintenance	145.	
	1,084.	Inspection	1,065.	
	1,660.	Pattern	2,307.	
		General Overhead Expenses		
	1,690.	Supervision & Clerical	2,218.	
	115.	General Labor	119.	
	600.	Laboratory Expense	548.	
	2,404.	Overtime Bonus	2,716.	
	72.	General Supplies & Misc.	99.	
	1,907.	Maintenance - Bldg. & Equip.	909.	
	877.	Light, Heat & Power	595.	
	149.	Water	126.	
	1,943.	Building Operation Expense	1,697.	
	1,160.	Depreciation - Machinery & Equip.	1,276.	
	1,321.	Employee Insurance	1,621.	
	242.	Vacation & Holiday Pay	994.	
	2,478.	Administrative, etc.	4,736.	
	$ 51,527.	Total Productive Cost	$ 62,866.	
		Cost per 100 lbs. Good Castings		
	$ 2.67	Melted Metal	$ 2.52	
	1.43	Direct Labor	4.55	
	3.90	Dept'l. & General Overhead	8.30	
	$ 15.20	Total	$ 15.37	
	- .10	Cleaning Dept. - Misc. Work	- .17	
	$ 15.10	Net Cost	$ 15.40	
		Deliveries		
	325,935 lbs.	Good Castings	393,038 lbs.	
	$ 42,489.	Transfer Value	$ 60,462.	
	30.144.	Actual Cost	61.719.	
	$ 7,673. (Loss)	Closed Order Adjustment	$ 1,457. (Loss)	

EXHIBIT 1

production times and rates for the operations performed. These are the same standard times and rates on which operators are paid under a comprehensive incentive system in force covering all productive processes and some nonproductive ones. Variance accounts are charged or credited. Material cost variance is divided between price variance and yield variance, the latter somewhat reflecting the judgment of the foundry superintendent in setting reasonable standard yields for castings of various sorts. A normal defective or scrap loss is recognized as a separate element of cost.

Detailed Cost Reports

Appended to this presentation are two examples of cost reports maintained. These are a form of labor cost analysis, shown as Exhibit 4, and a combined unit cost and performance ratio analysis, the contents of which are given in the table comprising Exhibit 5. It will be quickly seen that the former, which is a line-a-week sheet showing actual figures derived from payroll classification totals and production quantities, also provides in the columns headed "cost per M units" an analysis of variances from standard for each class of labor. An extensive cost display on a line-a-month basis is afforded by the complete form from which Exhibit 5 is developed, and shows a wider range of cost elements, broken down by department and class of expense, with values reduced to a cost per hundred pounds of good castings produced. It will be noted that each exhibit shows, for comparison, standard costs at a weekly or monthly volume and that the actual data to be added to show actual performance provides comparison of volume as well as cost. The labor report is based on piece costs; the more detailed monthly anaylsis on cost per hundred pounds. The standard cost elements shown on the latter are a condensation of the foundry operating budget previously constructed to reflect the production load indicated and the predetermined costs at that volume.

Conclusion

We feel that our system as a whole, while doubtless not perfect, has many positive virtues. The standards developed serve reliably for pricing and inventory as well as to implement the control of costs displayed at actual in the over-all operating statement. Our foundry operation itself is more than ordinarily complete. The existence of our technical departments gives stimulus to a thoroughgoing approach to our accounting problems, too.

STANDARD ROUTING, RATES & COST

Name MIDDLE COVER — Part No. 15961-F

Sheet No. 2 of 2 sheets — Routing Checked by [illegible] — Date 5-17-47 — Routing Chg. No. [illegible]

Operation 5-16-47 — Dept. No. 61 — Work Ctr. [illegible] — Set-up Hrs. [illegible] — Oper. Hrs. [illegible] — Unit Time [illegible] — Prod. [illegible]

No.	Operation Description	Dept. No.	Work Ctr.	Set-up Hrs.	Oper. Hrs.	Unit Time	Prod.
1	MAKE CORES	61		C			C
2	FILE & BURRY	61		C			3.00
3	MOLD - FLOOR - 1	61		B			18.14
4	PIPES	61		B			.67
5	SHIFT WEIGHTS	61		C			.07
6	SHAKE OUT	61		F			2.00
7	WET SAND	61		F			.11
8	PILE SAND IN CORE FOR CUTTING	61		C			.34
9	CUT SAND	61		C			1.09
10	TRUCK TO SCALE REMOVE CORES, SPRUES & GATES	61		F			.30
11	TRUCK CASTING	61		C			.19
12	CLEAN FLOOR	61		C			.21
13	HOUGH INSPECT & COUNT	2E		C	2.		.30
14	ANNEAL	61		C			.26
15	CLEAN - WHEELABRATOR	61		F			2.80
16	GRIND - MORTON	61		C			1.40
17	FINISH INSPECT	2E		C	2.		.25
18	PRIME - DIP	61		C	3.		.23
19	FOUNDRY STORES	4X					
20	OPER. CUT SAND OPERATOR HELPER			F C			
21	NOTE: DISC ROUTING FOR REQ. 4098-5A17						
22							
23							
24							
25							

Box No. 1
Class 4
No. to Job 1
Type Box N
Make 3.13

(Values shown are NOT ACTUAL — they are shown for illustration purposes only)

Part No. 15961-F — MIDDLE COVER

EXHIBIT 2

IRON FOUNDRY COST CARD

NAME Middle Cover PART NO. 15561-F

	No. of Castings	Wt. Per Casting	Total Weight		Standard Value	
					Rate	Amount
Good Castings (G)	592	9.50	9424.00	Molded on Floor ☑ Bench ☐ Squeezer ☐	2.2847	9.15
Defective Castings (D)	5	9.50	47.50	Castings per Mold 1		
Sprues and Gates (S)	700	3.25	3250.00	Yield = 100-Pattern Loss 5 % x G = 68 %		
Total Weight (G, D and S)			12721.50	G, D and S		
				Defectives = 5 % of Good Castings		

DETAILS OF COST

ITEMS	DATE 2-28-47 Units Rate per Hr.	Cost Each	DATE Units Rate per Hr.	Cost Each	DATE Units Rate per Hr.	Cost Each	DATE Units Rate per Hr.	Cost Each
Metal Cost 68 % Yield .024 Cost Per Lb.		.576						
Make Cores	6.70 18.-	.121						
Burden	33.-	.222						
Total Labor and Burden		.343						
Defectives 5 %		.017						
Total Coremaking Cost		.360						
Mold and Pour								
Shake Out-Cut Sand-Shift	12.95 18.-	.416						
Burden	59.-	.666						
Total Labor and Burden		1.080						
Defectives 5 %		.054						
Total Molding Cost		1.134						
Clean and Prime	4.43 18.-	.080						
Burden	47.-	.208						
Total Labor and Burden		.288						
Defectives 3 %		.009						
Total Cleaning Cost		.297						
Anneal .025 Lb.		.048						
Inspect	.56 18.-	.010						
Burden	43.-	.024						
Total Labor and Burden		.034						
Defectives 3 %		.001						
Total Inspection Cost		.035						
TOTAL FOUNDRY COST		2.150						
Material		.576						
Labor		.652						
Burden		1.222						
Total Units	$1.69							

(Values shown are NOT ACTUAL — they are shown for illustration purposes only)

EXHIBIT 3

THE DYER COST CONTROL ANALYSIS — APPLIED TO — THE DE LAVAL SEPARATOR CO., POUGHKEEPSIE, N. Y.

PLANT De Laval — DEPT. #61 - IRON FOUNDRY — SUPERVISOR C. Hanks

PERIOD ENDING 1947	Per Cent Operating	Per Cent Set Up	TOTAL PIECE UNITS PRODUCED	DIVISION OF PAY ROLL: PRODUCTIVE	WASTE	NON-PRODUCTIVE: SET-UP	NON-PROD.	TOTAL	COST PER "M" UNITS: STANDARDS: Prod.	Waste	Set-Up	N.-Prod.	TOTAL	EFFECTIVENESS: Cost Control Factor	Per cent earned	Operating Time Factor	Efficiency	Operating Time Factor
Standard			172,000						17.30	.35	.20	7.29	25.14					
Reference									IN EXCESS OF STANDARD				ACTUAL 42.74	17	60			
JAN. 5	86	1	148600	3335.57	149.39	31.07	1659.77	5175.80	5.15	.66	.01	3.87	34.83	1.31	55	89	73	14.6
12	114	1	195500	4221.63	366.09	38.44	2169.53	6795.69	4.29	1.52	--	3.81	34.76	1.31	56	88	73	14.2
19	110	1	209100	4745.38	316.53	44.04	2369.64	7475.59	3.49	1.13	-.01	3.99	35.75	1.25	64	95	75	16.5
26	108	1	204700	4671.03	324.69	45.45	2341.15	7382.32	3.62	1.21	--	4.08	36.06	1.26	62	95	74	15.9
FEB. 2	107	1	204000	4716.49	392.52	46.14	2374.32	7529.47	3.92	1.54	.01	4.29	36.91	1.29	58	93	74	15.2
JAN.	105	1	961900	21690.10	1549.22	205.14	10914.41	34358.87	4.11	1.24	--	4.02	35.72	1.29	59	92	74	15.2

(Values shown are NOT ACTUAL -- they are shown for illustrative purposes only.)

EXHIBIT 4

OPERATING UNIT COSTS AND RATIOS

Item	*Standard*	*January*	*Actual February, etc.*
Pounds charged	456,000	606,792	—
Cost per 100 lbs. poured			
Metals and alloys	$1.10	$1.22	—
Melting labor	.19	.18	—
Electric energy	.43	.35	—
Electrodes	.19	.12	—
Repair and maintenance supplies	.33	.20	—
Total cost at spout	2.24	2.07	—
Pounds produced	296,000	408,287	—
Cost per 100 lbs. good castings			Values given are not actual
Melting			
Metal cost	2.82	2.52	
Sand molding			
Direct labor	2.20	2.61	—
Indirect labor	.63	.70	—
Repair and maintenance supplies	.50	.66	—
Core making			
Direct labor	.82	.82	—
Indirect labor	.23	.40	—
Repair and maintenance supplies	.31	.26	—
Cleaning and finishing			
Direct labor	.52	.85	—
Indirect labor	.72	.70	—
Repair and maintenance supplies	.66	.68	—
Annealing			
Labor	.09	.05	—
Repair and maintenance supplies	.08	.04	—
Inspection			
Labor	.17	.10	—
Burden	.26	.17	—
General overhead			
Supervision and clerical	.49	.54	—
General labor	.25	.83	—
Repair and maintenance supplies	.22	.22	—
Light, heat, and power	.19	.14	—
Patterns	.35	.56	—
Fixed charges and administrative	3.06	2.55	—
Total cost	14.57	15.40	—
Pounds delivered		393,038	—
Cost of deliveries		$61,919	—
Value of deliveries		60,462	—
Gain or (loss), total		(1,457)	—
Per 100 lbs.		(37¢)	—
K W H per 100 lbs. charged		28	—
Per cent to pounds charged yield		67.3%	—
Furance loss (or gain), etc.		2.9%	—
Defectives—Main plant		7%	—
Foundry		6.6%	—
Sprues and gates		19.0%	—
Pigged metal		3.5%	—
Pounds delivered—Main plant		360,417	—
Customers		32,621	—
Per cent returns to deliveries—			
Main plant		1.2%	—
Customers		—	—
Pounds good castings—Per man hour		19.9	—

EXHIBIT 5